

Title: Use of a metal salt of a fatty acid for damping vibrations, method for assembling a mirror adjustment mechanism, mirror adjustment mechanism

The invention relates to a mirror adjustment mechanism for adjusting a mirror element of a mirror unit of a motor vehicle, comprising a base plate which can be fixedly mounted to the motor vehicle, and a mirror holder for supporting the mirror element, wherein the mirror holder is furthermore  
5 adjustably connected with the base plate via cooperating surfaces of the mirror adjustment mechanism.

Such a mirror adjustment mechanism is known, for instance, from the Dutch patent publication NL 1015428, where the mirror adjustment mechanism is used to adjust a mirror element in a mirror housing of a motor  
10 vehicle. More specifically, the angular position of a mirror element can be varied with respect to a frame that is mounted to the mirror housing, such that a driver of the motor vehicle has an optimum field of vision in rearward direction. Also, such a mirror adjustment mechanism can be used to adjust the mirror housing inclusive of the mirror element relative to a base plate which is  
15 fixedly mounted on the motor vehicle.

At relatively high speeds of the motor vehicle, or when driving over a road having a rough surface, such as an unimproved road, the mirror element may start to vibrate under the influence of forces exerted by the air flowing past, or as a result of forces transmitted to the mirror housing via the wheels.  
20 The cooperating surfaces of the mirror adjustment mechanism then perform vibrations relative to each other. More particularly, the cooperating surfaces alternately move away from and towards each other, or along each other in a direction substantially parallel to one of the cooperating surfaces. Also, a combination of the above-mentioned movements is possible. The vibration of  
25 the mirror element adversely affects the driver's view in rearward direction, which is undesired, for instance for reasons of safety.

There are different mechanical constructions known which envisage a vibration-absorbing effect, such as hydraulic or pneumatic shock absorbers and shock damping actuators. Often, however, these are costly, non-compact and less reliable constructions.

5       The object of the invention is to obtain a mirror adjustment mechanism of the type mentioned in the opening paragraph hereof, in which vibrations are prevented. More particularly, the invention contemplates a mirror adjustment mechanism in which vibrations performed by the cooperating surfaces of the mirror adjustment mechanism relative to each other are damped. To that end,  
10       a metal salt of a fatty acid is used.

Surprisingly, it has been found that through the use of such metal salts, the cooperating surfaces of the mirror adjustment mechanism vibrate less at relatively high speeds of the motor vehicle or when driving over a road having a rough surface. The metal salt of a fatty acid, also designated as "fatty acid  
15       salt" or "metal soap", has a lubricating action in low-frequency pivotal motions, while at higher frequencies, a vibration-absorbing action is involved. This effect could be ascribed to the energy absorption that occurs in the metal salt possibly behaving as a fluid. It is supposed that upon a high-frequency pivoting of the cooperating surfaces, metal salt particles situated close to one  
20       of the surfaces move to a lesser extent relative to that surface than metal salt particles that are further removed from that surface. The friction thereby arising could prevent the unwanted pivotal motion. According to another possible explanation, the vibration-absorbing effect is obtained in that particles of the metal salt like ball bearings behave as a lubricant at relatively  
25       low frequencies, while at relatively high frequencies, by contrast, friction arises between the particles of metal salt and the cooperating surfaces.

Metal soaps are generally known to be applicable as grease, lubricant, anticlotting agent, tableting aid, hydrophobing agent, separating agent, chemical stabilizer, defoamer and/or detaching agent.

The metal in the metal salt of a fatty acid can be any suitable metal, such as an alkali or alkaline-earth metal, or other metal. Suitable metals are *inter alia* magnesium, calcium, aluminum, zinc, lead, sodium, potassium, barium, lithium, copper, tin, iron, chromium or zirconium. Preferably, the  
5 metal is magnesium, calcium, aluminum or zinc, more preferably zinc.

The fatty acid in the metal salt of a fatty acid can be a natural or synthetic fatty acid. Natural fatty acids can be obtained from vegetable or animal sources in manners well known in the art, and such sources include, but are not limited to, vegetable oils, nut oils and seed oils, such as almond oil,  
10 castor oil, coconut oil, corn oil, cottonseed oil, jojoba oil, linseed oil, grapeseed oil, rapeseed oil, mustard oil, olive oil, palm oil and palm kernel oil, peanut oil, safflower oil, sesame oil, soybean oil, sunflower oil, crambe oil, wheat germ oil, and cocoa butter; and animal oils and fats, such as lanoline, chicken fat, tallow, lard, beef fat, butterfat, mink oil, and fish oils.

15 The fatty acids can be fatty acids having a saturated, unsaturated, unbranched or branched chain. Very suitable fatty acids are the following higher fatty acids (C6-C24), specified by the standard chemical name, along with the common name, the number of carbon atoms and the number of double bonds in the fatty acid chain: hexanoic acid (caproic acid; C6:0); heptanoic acid  
20 (C7:0); octanoic acid (caprylic acid; C8:0); nonanoic acid (pelargonic acid; C9:0); decanoic acid (capric acid; C10:0); undecanoic acid (C11:0); undecylenic acid (C11:1); dodecanoic acid (lauric acid; C12:0); tridecanoic acid (C13:0); tetradecanoic acid (myristic acid; C14:0); tetradecenoic acid (myristoleic acid; C14:1); pentadecanoic acid (C15:0); pentadecenoic acid (C15:1); hexadecanoic  
25 acid (palmitic acid; C16:0); hexadecenoic acid (palmitoleic acid; C16:1); hexadecadienoic acid (C16:2); hexadecatrienoic acid (C16:3); heptadecanoic acid (margaric acid; C17:0); heptadecenoic acid (margaroleic acid; C17:1); octadecanoic acid (stearic acid; C18:0); 9-octadecynoic acid (stearolic acid; C18:1); [Z]-9-octadecenoic acid (oleic acid; C18:1); [E]-9-octadecenoic acid  
30 (elaidic acid; C18:1); [R-[Z]]-12-hydroxy-9-octadecenoic acid (ricinoleic acid;

C18:1); [Z,Z]-9,12-octadecadienoic acid (linoleic acid; C18:2); [Z,Z,Z]-9,12,15-octadecatrienoic acid (linolenic acid; C18:3); octadecatetraenoic acid (C18:4); nonadecanoic acid (C19:0); eicosanoic acid (arachidic acid; C20:0); [Z]-9-eicosenoic acid (gadoleic acid; C20:1); eicosadienoic acid (C20:2); eicosatrienoic acid (C20:3); [all-Z]-5,8,11,14-eicosa-tetraenoic acid (arachidonic acid; C20:4); eicosapentaenoic acid (C20:5); docosanoic acid (behenic acid; C22:0); (Z)-13-docosenoic acid (erucic acid; C22:1); docosadienoic acid (cetoleic acid; C22:2); docosatrienoic acid (C22:3); docosatetraenoic acid (C22:4); docosapentaenoic acid (C22:5); docosahexaenoic acid (C22:6); tetracosanoic acid (lignoceric acid; C24:0); tetracosenoic acid (C24:1); and/or stereoisomers thereof; and/or derivatives thereof, such as for instance hydroxystearic acid; and/or branched chain derivatives thereof, such as for instance isostearic acid.

Derivatives of fatty acids that can be used in embodiments of the invention comprise fatty acids that are substituted with alkyl, aryl, acyl, heteroaryl, halogen, hydroxy or alkoxy.

The term "alkyl", or "alk" (*i.e.*, derivative forms of alkyl, as in, for instance, "alkoxy") refers to optionally substituted straight chain or cyclic monovalent alkane (saturated hydrocarbon)-derived radicals containing 1 to 12 carbon atoms. If substituted, alkyl groups may be substituted with up to 4 substituent groups at any available binding position. Examples of alkyl groups comprise, but are not limited to, methyl, ethyl, propyl, isopropyl, *n*-butyl, *t*-butyl, isobutyl, pentyl, hexyl, isohexyl, heptyl, octyl, nonyl, decyl, undecyl, dodecyl and the like. The alkyl may be optionally substituted with one or more halogens.

The term "aryl", or derivative forms thereof, refers to monocyclic or bicyclic aromatic rings, e.g., phenyl, substituted phenyl and the like, as well as groups which have fused, e.g. naphthyl, phenanthrenyl and the like, containing from 6 to 30 carbon atoms. Accordingly, an aryl group can contain at least one ring with 6 atoms, while up to 5 of such rings can be present, having therein 22 or 30 atoms, depending on optionally alternating (resonating) double bonds between carbon atoms or suitable hetero atoms.

Examples of aryl groups comprise, but are not limited to, phenyl, naphthyl, anthryl, biphenyl and the like.

The term "acyl" refers to the radical  $\text{RCO}^-$ , alone or in combination, for instance with oxygen, nitrogen, sulfur, etc.

5       The term "heteroaryl" refers to a monocyclic aromatic hydrocarbon group having 5 or 6 ring atoms, or a bicyclic aromatic group having 8 to 10 atoms, containing at least one hetero atom, O, S or N, in which a carbon or nitrogen atom is the point of attachment, and in which one or two additional carbon atoms are optionally substituted by a hetero atom selected from O or S, and in which from 1 to 3 additional carbon atoms are optionally replaced by  
10       nitrogen hetero atoms, the heteroaryl group mentioned being optionally substituted as described herein. Examples of heteroaryl groups comprise, but are not limited to, thienyl, furyl, pyrrolyl, pyridinyl, imidazolyl, pyrrolidinyl, piperidinyl, thiazolyl, oxazolyl, triazolyl, pyrazolyl, isoxazolyl, isothiazolyl,  
15       pyrazinyl, pyridazinyl, pyrimidinal, triazinylazepinyl, indolyl, isoindolyl, quinoliny, isoquinoliny, benzothiazolyl, benzoxazolyl, benzimidazolyl, benzoxadiazolyl, benzofurazanyl, etc. The heteroaryl groups can be optionally substituted by one or more groups which comprise, but which are not limited to, halogen, alkyl, alkoxy, hydroxy, carboxy, carbamoyl, alkyloxycarbonyl,  
20       trifluoromethyl, cycloalkyl, nitro, cyano, amino, alkyl-S(O)<sub>m</sub> (wherein m=0, 1 or 2), thiol and the like.

The term "halogen" or "halo" refers to chlorine, bromine, fluorine or iodine, the preferred halogen being bromine.

25       Preferably, the fatty acid in the metal salt of a fatty acid is selected from the group consisting of C8-C24 fatty acids, more preferably from the group consisting of C14-C22 fatty acids. Still more preferably, unbranched, naturally occurring fatty acids having between 14 and 22 carbon atoms are used. Particularly preferred are the C16-C20 fatty acids which can be obtained from tallow, the most preferred fatty acid being stearic acid.

The metal salt of a fatty acid can be obtained in any known manner. Thus, for instance, very suitably, an oil or fat as a source of a fatty acid can be saponified with a metal hydroxide, whereby the ester bonds are hydrolyzed and the fatty acids are split off from the glycerol backbone. The skilled person  
5 is familiar with the methods that can be used for that purpose. Thus, for instance, a metal salt of a fatty acid can be prepared from tallow, an animal fat having a melting point above 40°C which consists substantially of completely esterified fatty acid-glycerol esters, by saponifying the tallow in water with an alkaline solution of a metal hydroxide, optionally followed by salting out the  
10 excess alkali and separating the soap from the glycerol to obtain the metal salt of a fatty acid. In this way, mixtures of fatty acid salts are obtained, which can also find application in embodiments of the invention. Mixtures of fatty acid salts where, as metal of the metal salt, sodium or potassium is used are generally called soap.

15 Suitable metal salts of a fatty acid are also commercially available, *inter alia* from Peter Greven Fett-Chemie, Münstereifel, Germany and from AKM, forming part of Safic Alcom, Malford Court, Hardwick Grange, Warrington, United Kingdom.

The metal salt of a fatty acid can in principle be used in any form, but is  
20 preferably used in the form of a powder.

The most preferred metal salt of a fatty acid that is used in aspects of the present invention is zinc stearate (octadecanoic acid) also known by the name of talculin Z (CAS No.: 557-05-1), preferably in powder form.

By using a metal salt of a fatty acid which adheres to the cooperating  
25 surfaces of the mirror adjustment mechanism, such as, for instance, an organophilic substance when plastic surfaces are used, what is achieved is that molecules situated close to one of the cooperating surfaces are relatively difficult to displace relative to that surface. This enhances the occurring friction at high frequencies, so that absorption improves as well. Moreover,

once applied, the substance remains better present at the desired location, viz. the cooperating surfaces.

Preferably, the metal salt is hydrophobic, so that the mirror adjustment mechanism continues to function in case of frost as well, while preventing rust  
5 on metal parts near the mechanism.

Advantageously, the substance can be applied in powder form on at least one of the cooperating surfaces. The substance is preferably applied directly onto the surfaces, for instance by spraying or by atomization. It is also possible, however, to apply the substance onto neighboring parts of the mirror  
10 adjustment mechanism. In some way or other, amounts of such applied substance can subsequently end up on the above-mentioned surfaces as well, for instance through shifting or atomization.

The invention further relates to a method for assembling a mirror adjustment mechanism.

15 The invention also relates to the use of a metal salt of a fatty acid.

Further advantageous embodiments of the invention are set forth in the subclaims.

The invention will be further elucidated with reference to exemplary embodiments which are represented in the drawing. In the drawing:

20 Fig. 1 shows a perspective schematic view of a mirror adjustment mechanism according to the invention;

Fig. 2 shows a schematic side view of a partly cutaway mirror adjustment mechanism of Fig. 1; and

25 Fig. 3 shows a schematic side view of another mirror adjustment mechanism according to the invention.

The figures are only schematic representations of preferred embodiments of the invention. In the figures, the same or corresponding parts are indicated by the same reference numerals.

Figs. 1 and 2 represent an embodiment of a mirror adjustment mechanism  
30 1 for adjusting a mirror element of a wing mirror unit of a motor vehicle

according to the invention. The mirror adjustment mechanism 1 comprises a substantially spherically curved holder 2 which constitutes a first hinge part, and a substantially spherically curved ring 3 which constitutes a second hinge part of the mirror adjustment mechanism 1. The holder 2 is supported by a mirror\_

5 housing (not shown). The ring 3 serves as mirror holder and is arranged for supporting a mirror element (not shown either), for instance with the aid of a mirror supporting plate which is attached to the ring 3, for instance via a snap connection. By means of a second hinge mechanism, the frame is attached to a base plate which can be fixedly mounted to the motor vehicle.

10 By adjusting the ring 3 relative to the holder 2, the mirror element can be adjusted, so that a driver's view rearwards of the motor vehicle can be set optimally. In the embodiment shown, adjustment of the ring 3 and the holder 2 occurs through a hinging movement. Hinging the ring 3 relative to the holder 2 is done by pivoting cooperating surfaces. More particularly, a part 12 of the

15 outer surface of the holder 2 cooperates with a part 13 of the inner surface of the ring 3, as shown in Fig. 2. As the holder 2 is being pivoted relative to the ring 3, the cooperating surfaces 12, 13 slide along each other, so that the ring 3 can rotate relative to the holder 2.

On at least one of the mutually facing cooperating surfaces 12, 13, zinc

20 stearate in the form of a powder has been applied, so that vibrating movements performed by the cooperating surfaces 12, 13 relative to each other, are damped. This prevents vibration of the mirror element relative to the frame and the base plate at high speed or in case of a rough road surface. Generally, the zinc stearate functions as vibration damper from a frequency of

25 approximately 40 Hz, as with vibrations of a frequency around 100 Hz. A powder is herein defined as a substance of ground, pulverized or otherwise finely divided solid particles of a grain size between 1 and 100 micrometers, preferably of a grain size of less than 75 micrometers, still more preferably of less than 45 micrometers. To be used, for instance, is zinc stearate

30  $(\text{Zn}(\text{C}_{15}\text{H}_{35}\text{O}_2)_2)$  with zinc (typically 10.8%) and ash (13.5%), having a volatility



of 0.2% at a temperature of 105°C, having a melting point of 119°C, and to which a high content of organic material has been added.

The substantially spherical holder 2 is hingeable relative to the substantially cup-shaped ring 3 about a first axis A, which is situated in a plane which is substantially parallel with the top surface of the holder 2. Further, the mirror adjustment mechanism 1 comprises driving means which are present to enable the holder 2 to be pivoted relative to the ring 3. These driving means comprise a non-straight driving rod 4, bearing mounted in the holder 2, as well as means for activating the driving rod 4. The driving rod 4 has the shape of a ring segment which is rotatable relative to an axis C. This axis C is at an angle of 45° with respect to the axis A. The ring segment is provided with teeth which are in mesh with the teeth of an output gear wheel of a driving system. This driving system comprises a motor and an associated drive train; for the sake of simplicity, however, these components are not shown. By energizing the motor, and through the intermediacy of the drive train, the gear wheel is driven, resulting in displacement of the ring segment in the holder 2. As the driving rod 4 is connected with a driving part 5 which is mounted in a recess 6 in the ring 3 so as to be rotatable relative to an axis B which is perpendicular to the axis A, a displacement of the driving rod 4 in the holder 2 means that the driving part 5 moves the ring 3 relative to the holder 2. The driving part 5 is here designed as a cylinder-shaped element. For more details, reference is made to the Dutch patent publication NL 1015428.

Further, the zinc stearate can be applied to at least one of the cooperating surfaces of, on the one hand, the teeth of the ring segment and, on the other hand, the output gear wheel of the driving system, or to cooperating parts in the drive train. This also prevents the occurrence of vibrations of the mirror element relative to the frame and the base plate. The cooperating parts connect the ring 3 with the base plate indirectly. However, a direct connection is also possible, as appears from Fig. 3.

Fig. 3 shows a second embodiment of a mirror adjustment mechanism 1 according to the invention, designed as an inside rearview mirror unit for a motor vehicle, where the mirror holder 11 is directly hinged to the base plate 13 via a ball hinge 12, without intermediacy of a second hinge mechanism. The mirror holder 11 supports a mirror glass 16. The ball hinge 12 comprises a ball-shaped body 14 which is fixedly connected with the base plate 13 and which is situated in a cavity 17 in the mirror holder 11. In the space 15 between the ball 14 and the wall of the cavity 17, the zinc stearate has been applied.

The invention is not limited to the exemplary embodiments described here. Many variants are possible.

Thus, the orientation of the driving rod is not necessarily chosen as shown in Fig. 1, but can for instance be chosen such that the driving rod can move in a plane perpendicular to the axis A. In addition, the driving rod can be of a different shape, for instance substantially straight, with a terminal end engaging a point on the mirror supporting plate.

Also, an entirely different drive of the mirror adjustment mechanism can be implemented. Nor, even, is it necessary to realize a motor-drive. By omitting the drive, an adjusting mechanism to be adjusted manually is obtained.

The substantially spherically curved ring can also be designed as a substantially spherically curved cup, as, for instance, in the mirror adjustment mechanism described in the Dutch patent publication NL 1012087. Also, the mirror adjustment mechanism can comprise cooperating dish parts of which cooperating surfaces can adjust the mirror element relative to the base plate. As appears from the second exemplary embodiment, the mirror adjustment mechanism can also comprise a ball hinge.

Further, the metal salt of a fatty acid can be used in the second hinge mechanism, so that the frame pivots relative to the base plate which is mounted to the motor vehicle.

Such variants will be clear to those skilled in the art and are understood to fall within the scope of the invention as set forth in the following claims.